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ABSTRACT

Drawing upon Elgin Community College's (ECC's) 7-year history of program development and operation, this paper demonstrates how ECC, in cooperation with Northern Illinois Industries, Computervision Corporation, Mazak Corporation, and the Society of Manufacturing Engineers, established a Computer-Aided Design and Drafting/Computer-Aided Machining (CADD/CAM) program, and how this program benefits industries in the surrounding area. Introductory comments describing ECC's initial involvement in CADD are followed by an enumeration of the advantages of CADD involvement for business and industry. The report continues by demonstrating how a CADD/CAM program enables the community college to meet its primary goal of providing realistic and quality instruction, while meeting industries' needs for entry-level designers. Next, the paper discusses how a student may become involved in the CADD program, the CADD classes offered at ECC, criteria for success in the field, and recommendations of ECC's advisory committee related to CADD/CAM classes. The report concludes by discussing the expansion of ECC technology to include industrial robotics, and the educational implications of computer-integrated manufacturing. Curriculum information on ECC's CADD and CAM classes and sample projects are appended. (LAL)

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A PROTOTYPE OF CAD/CAM EDUCATION IN THE COMMUNITY COLLEGE

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Presented at the 6th Annual Conference of the
National Computer Graphics Association
Dallas, Texas
April 14-18, 1985

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ABSTRACT

As CAD/CAM expands into all aspects of American manufacturing and technology, there is an increased need to determine what role this technology will play in the future of education at the community college level.

The purpose of this paper is to demonstrate how one community college in cooperation with Northern Illinois Industries, Computervision Corporation, Mazak Corporation, and the Society of Manufacturing Engineers established a CAD/CAM program, and, more importantly, how this educational program benefits industries in the surrounding area.

Elgin Community College (ECC) serves as a prototype for the community college's role in CAD/CAM training. The paper is based on the college's experience in teaching CAD since 1979 and offering a comprehensive CAD program including an Associate Degree (1982) utilizing a Computervision CADDS 4X system with five Designer V terminals. More recently (1983), a Mazak 3 axis CNC vertical machining center was fully integrated and hard-wired with the CAD system. This led to the establishment of an Associate Degree Program in Computer Aided Machining.

Additionally, a variety of reasons for the success of the community college, as exemplified by ECC in CAD/CAM training, are discussed including philosophy, policies, minimal tuition costs, and flexibility inherent in a community-based institution of this type.

INTRODUCTION

Elgin Community College's involvement in CAD began innocently in 1978 with a student tour of a local company using a Computervision CADDS I System for printed circuit board design. Discussions were soon underway with Motorola Corporation of Schaumburg, Illinois, as to how this emerging "new" technology could be incorporated into the school's mechanical and electrical design programs.

Plans were made to implement the CAD Program in January, 1979, at Motorola. Their CAD director provided the instruction utilizing Motorola's CAD laboratory. During the next two years that this course was being offered, Elgin Community College (ECC) was acquiring new acquaintances such as Travenol Laboratories of Deerfield, Illinois, and Computervision Corporation.

In December, 1981, Computervision and ECC joined forces to provide a variety of educational experiences to industries and students throughout Northern Illinois. This was achieved through plans for the partial donation of a CADDS IV System with five Designer V terminals.

By March, 1982, the cooperative effort between industry and education materialized with the first, on-campus CAD Program in Illinois and one of very few in the United States.

Since its conception, this program has expanded to include eleven classes in five different course offerings and involves each semester approximately 200 employed engineers, designers, drafters, technicians, and, of course, full-time engineering and technology students.

ADVANTAGES TO BUSINESS AND INDUSTRY

As more companies become involved in CAD or expand existing facilities and as Computervision users expand into Computer Integrated Manufacturing (CIM), the need for a larger number of engineers and technicians skilled in the use of the CADDS IV System increases and becomes more obvious.

Community Colleges with state of the art CAD can contribute significantly in meeting these educational needs. There are major advantages of using a facility like ECC's. A community college can:

1. Offer a variety of courses evenings, Saturdays, and holidays or at other times convenient to employed persons at a reasonable cost.

2. Offer a comprehensive related technical program in such areas as physics, data processing, manufacturing, electrical, etc. to compliment design skills of present CAD designers.

3. Provide a series of seminars and workshops dealing with topics for both users and non-users of CAD systems.

4. Reduce the need to tie up valuable terminal time training employees on the fundamental skills of CAD manipulation.

In addition to the training of employees, there are two other important benefits for manufacturers to consider. These are:

1. Some top manual designers are reluctant to get involved in CAD. The community college and its emphasis on sequential learning, informality, and class structure, can provide a non-threatening atmosphere for those individuals. We have discovered that less that 5% of those enrolled are not adaptable to this new design technology.

2. Of special importance to companies getting started in CAD is the availability of part-time employees who are willing and capable of helping to digitize drawings, build parts libraries, etc. They could be employed weekends during off hours and relieve designers and engineers of these tedious, but necessary, tasks.

A CHANGING WORLD

"The world is changing today at a more rapid rate than any time in its history." The community college, its policies and philosophy as established in Illinois, is designed to meet the changing educational needs of people and industry in the decade ahead.

The open-door policy admits any person over eighteen years of age who can benefit from the education. This simply means that an experienced designer can take CAD courses without having completed two years of high school foreign language or having graduated in the upper 20% of his high school class.

Because of its close association with professional organizations and industrial personnel, community colleges recognize the value of work experience. This experience can be applied in meeting individual course prerequisites and graduation requirements. By keeping our

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prerequisites to a minimum, and by acknowledging this work experience, we have allowed machine tool technicians, N/C programmers and designers who lack formal education access to our series of CAD courses.

There are times when full-time staff are not qualified to teach the newest technologies. The only requirements for technical instructors in the community college is a comprehensive knowledge of the subject matter. This allows us to go to industry for leaders in a particular field to provide the instruction. Our CAD program has benefited immensely from the expertise provided by local users of CV equipment.

Another distinct advantage of community colleges is the flexibility in class scheduling. If equipment and instruction are available, the community college will do its best to provide you with the training that your company needs. Community colleges will offer technical or expanded course offerings in the summer and evenings. And, if there is a need, courses can be scheduled for Saturdays, holiday breaks, and/or between semesters. These courses can be established for college credit or noncredit, a duration of eight weeks or two days, and they can be an hour or two per week or eight hours a day.

It is the philosophy of two-year institutions to provide quality education at the lowest possible cost. Because of the generosity of Computervision Corporation and the community college philosophy, the total cost of 48 hours of lecture, demonstrations, and hands-on experience for the introduction course is less than $70. A unique chargeback system in Illinois makes this low-cost tuition available to most residents of Northern Illinois.

THE COMMUNITY COLLEGE RESPONSIBILITIES

The primary goal is to provide realistic and quality instruction. This includes meeting industries' needs for entry-level designers in a variety of fields. These designers must have, in addition to their traditional courses of industrial design, math, drafting, manufacturing, etc., an excellent knowledge of the newest technology, CAD/CAM. In addition, if we are to provide retraining to thousands of experienced designers and technicians, the education must equal or surpass that which is provided in-house or at the vendor schools. The ECC prototype of CAD education is well on the way to accomplishing this goal.

The unique features which have contributed to this success are as follows:

1. Utilize local CV users and industrial advisory committees to assist in establishing course objectives, content, and laboratory experiences. This has allowed us to provide educational experience similar to the ones they would perform when working on a CAD system.

2. Through the use of a combination of CAD experts from industry and full-time CV trained staff members for instruction, ECC has provided relevant and realistic education. Constant communication between these instructors will provide continued improvement and updating of instruction and curriculum.

In addition to providing realistic and quality instruction, the college has several other obligations to meet. The community college can:

1. Provide demonstrations and consultations to industries seeking to expand their knowledge about CAD/CAM. Instead of using execute files, in providing the demonstration, we have the participants get hands-on experience under the guidance of an instructor. These have been extremely effective in getting across the capabilities of the system.

2. Provide speakers to local manufacturing groups, chambers of commerces, and professional organizations. In addition to speaking, staff members are strongly encouraged to be active members of professional organizations. Not only does this increase enrollment, but it also helps to disseminate their knowledge about CAD/CAM to the professional community.

3. Offer information to other educational institutions. The college has received requests for information on CAD education from colleges and universities from California to Massachusetts and from Canada to Florida. ECC is pleased to have the opportunity to share its experiences in establishing a CAD program.

4. Provide a placement service for companies seeking both entry-level and experienced designers with expertise in CAD.

5. Provide workshops and seminars that deal with CAD as well as all aspects of Computer-Integrated-Manufacturing.

GETTING INVOLVED IN A CAD CLASS

The question often asked is, "How can I get involved in the CAD program?" CAD, as you know, is an extremely sophisticated tool to be used by an engineer, designer, or drafter to create industrial designs and drawings. To the high school senior, the housewife seeking employment, an individual seeking an occupational change, or the unemployed seeking a new career, the answer is simple. Begin by taking drafting, algebra, manufacturing, and physics for beginning designer skills. Then, sign up for your first experience on this engineering marvel. The remaining technical courses in the AAS Degree are interwoven between industrial design and the four required CAD courses.

For the experienced designer or the full-time student who has met the beginning prerequisites, entering the CAD program is a little more exciting. A special pre-registration is held for CAD and CAM students only. Numbers are given out on a Sunday evening for those wishing to register for classes the next day. Students began lining up in the morning of November 18, 1984 and when the last number was passed at 8:00 p.m. that evening, nearly 200 students had received their registration number. By the end of the first day of registration, over 200 students had enrolled in 11 sections with 270 openings for the various CAD and CAM courses.

THE CAD CLASS

The purpose of the education program in CAD is to provide learning experiences in the use and manipulation of the CAD system. We attempt to utilize the various Computervision software packages to their fullest extent. The present emphasis is on the in-depth study of mechanical, electrical, and numerical control. As many facets of the software packages are explored as possible in the time allotted. A partical list of topics covered includes 3 dimensional modeling detailing, advance surface design including spoles, the design and part figures into assemblies, use of execute files, generating tool paths, auxiliary views, fold-unfold flat patterns, and in electrical the use of merge and extract data, auto-route and auto-place.

ECC is presently offering six classes in CAD: Introduction to Computer Graphics, Mechanical Applications I, Electrical Applications I, Mechanical Applications II, Electrical Applications II, and Independent Research. These courses range in length from 48 contact hours for the introduction course to 96 contact hours for the advanced mechanical and electrical application courses. Each class has its scheduled lecture and demonstration time, and students are assigned in pairs for a specified number of laboratory hours each week. In order to accommodate as many students as possible, the labs

are open Monday thru Friday from 7:30 a.m. to 11:00 p.m. and Saturday from 8:00 a.m. to 8:00 p.m. Student's lab time is supervised by the instructor from his/her class. The student who completes the 5 regular CAD courses will have completed over 360 hours of lecture, demonstration, and laboratory hours.

In addition to the lab assignments and examinations, each student in all classes is required to construct a notebook containing new commands, on-line documentation, handout sheets, and notes taken during the lectures. As we are all aware, it is impossible to remember all the commands, especially those that we use only once in a while.

The student population in the various CAD courses is diverse. The day classes are primarily filled with full-time pre-engineering and technology students, although some companies are beginning to give their employees released time to attend day sections. The night introduction sections have a wide variety of participants, mostly employed individuals. This ranges from degreeded engineers and architects, presidents of corporations, designers, machine tool technicians, managers exploring the feasibility of purchasing a CAD system, and an occasional Ph.D. from the sciences.

CRITERIA FOR SUCCESS

First, age is not a factor to success in CAD education. All aged adults can easily compete with the younger generation. The mature people have a thorough knowledge of drafting and design, which seems to be the most important factor to success on the system. This enables the student to spend his or her time learning how to manipulate the commands rather than inserting geometry.

Secondly, one of the most difficult items for beginners to understand is that a computer cannot interpret what you are trying to tell it. If there is a punctuation error on this paper or someone forgot to insert a space on this paper, the reader will still know what is being said. A computer may try but cannot make that decision. An individual who has data processing programming experience knows this and benefits initially. However, by the end of the first course, this advantage has disappeared as has that of typing skills.

Third, one advantage to teaching CAD is that the students are highly motivated and are extremely enthusiastic about learning CAD skills. It is very seldom that one is absent from class, and our dropout rate is virtually nonexistent. The learning curve may vary for each student, however, all but a very few are successful. The staff has estimated that less than 5% of those who enter this program cannot adapt to this new method of design and drafting.

THE CAM CLASSES

An advisory committee consisting of both CNC and CAD users was set-up to assist in the writing of the curriculum and to determine the learning experiences for CAD and machining center. The recommendations and observations of this committee were as follows:

1. The machine tool specialist who utilizes CAD system for programming DNC will require different learning experiences from that of a designer.

2. CAM education will be no less complete than that offered to the CAD students. This training must include: advanced surfacing techniques-an ability in tool creation and definiation-part verification-measurements. The student must have the ability to: generate and edit tool paths for drilling, milling to 5 axis, as well as turning applications.

3. The students must have the ability to create and utilize punched tapes, and to program the system manually.

4. Five courses must be established to provide sequential learning experiences which are necessary to train machine tool technicians in the use of both the CAD and CAM. Two of these courses involved extended CAD experiences in establishing tool paths for machining of pre-designed parts. Part programs are interfaced from the Computervision CAD system to the Mazak machining center to enable machining with the stored data. Two courses are related to manual programming of N/C and CNC, and also using a source program to produce a paper tape. The final course allows the student to select special projects in an area of their choice.

CONCLUSION

Through the cooperative efforts of many individuals and corporations, Elgin Community College was fortunate in being able to establish one of the first community college CAD/CAM Training Centers. However, this is only the beginning of this and other community colleges' responsibility. College planning staff must continue to expand educational opportunities in CAD/CAM and establish a complete Computer Integrated Manufacturing (CIM) Training Center.

The next phase in the establishment of a CIM Training Center is robotics. Once again this cooperative effort between a major vendor (Automatix Corporation), industrial support, Society of Manufacturing Engineers, and the College's commitment to high tech education has produced results. ECC will have on campus this school year an Automatix 800 robot and AI 32 controller with vision.

Expansion of the ECC technology offerings to include industrial robotics will not only provide an exceptional experience itself, but will, in combination with the developed programs in CAD and CAM, provide an exceptional combination of experiences with emphasis toward flexible manufacturing systems and computer integrated manufacturing. This combination, with the addition of the Automatix industrial robot, will enable ECC to provide the type of education that is essential to manufacturing engineers and technicians of today. The software necessary to enable interface of the Automatix robot with the College's present CAD/CAM system is being developed. This will allow ECC to be one of the first colleges to offer off-line programming of robotic movements.

Other instructional areas will be affected by the addition of a robotic workcell. The electronics department will not only gain new insight with its integration into their existing programmable controller, but also gain from on-line programming and the electronic portion of robotics maintenance. Computer Aided Machining students will experience the integral unit of programming machinery with programmed loading, unloading and basic part inspection. Additionally, these students will recognize the problems involved in jig and fixture and workholder design. With the capabilities of the CADDS 4 system to integrate and graphically illustrate the programmed movements, the Computer Aided Design students will also broaden their experiences and awareness of the opportunities in industrial applications of the computer will be recognized.

As CIM spreads throughout manufacturing, all engineers and technicians must have the ability to input their expertise and/or extract data generated on a CAD/CAM system. Thus, the implications for the field of education are:

1. All preengineering and technology students, whatever their field of specialization, must have the ability to manipulate the system. CAD/CAM is far more than a drafting and design tool. This need requires rewriting many existing instructional programs (electronics,

welding, plastics, and manufacturing) to include CAM/CAM along with the latest advancements in the individual areas of instruction.

2. The community college must expand their course offerings beyond mechanical and electrical to include: finite element modeling, architectural, systems manager, plant layout, systems administrator, special projects, and robotic off-line programming.

Additionally, a short course for exploring the feasibility of purchasing a CAD/CAM system should be provided.

Additionally, the next few years will bring changes in education that today seem remote and improbable. Hopefully, we at ECC will be able to meet these challenges and, at the same time, share our knowledge and experiences with other colleges and industries throughout the nation.

COMPUTER AIDED MACHINING

First Semester

MTO 105	Machine Tool Processes I	5
MTO 106	Mathematics for Machinists	5
GET 107	Technical Graphics	2
	Required Communications Course	3
	Total	15

Second Semester

MTO 110	Machining Tool Processes II	5
MTO 112	Metrology	3
MTO 113	Design and Fabrication of Machining Parts	4
MTO 111	Introduction to N.C.	1
CAM 101	Introduction to Computer Programming	2
	Total	15

Third Semester

CAM 220	Computer Aided Machining I	4
CAM 221	Computer Aided Programming	3
MTO 203	Machine Part Processing	3
MTH 107	Technical Mathematics or MTO 109 Tech. Math II	4
PSY 100	Introduction to Psychology	3
	Total	17

Fourth Semester

CAM 222	Computer Aided Machining II	4
MTO 212	Jig and Fixture Theory	2
CAM 223	Special Problems in NC/CNC Programming	2
MTO 214	Metallurgy	2
	Liberal Education Requirement.	3
	Required Communications Course	3
	Total	16

Program Total 63

COMPUTER AIDED DESIGN AND DRAFTING TECHNOLOGY

First Semester

DFT 101	Basic Technical Drawing Skills	4
MTH 107	Technical Mathematics I or MTH 111 Intermediate Algebra	4
	Required Communications Course.	3
ELM 119	Electro-Mechanical Fundamentals or ELS 100 Basic Electronics	4 or 5
	Total	15 or 16

Third Semester

DFT 206	Industrial Design Problems	5
CAD 113	Computer Graphics: Electrical Applications I	3
DFT 207	Applied Math for Drafting and Design	3
PHY 105	Technical Physics	4
	Liberal Education Requirement.	3
	Total	17

Second Semester

DFT 102	Descriptive Geometry	4
MTH 109	Technical Mathematics II or MTH 112 College Algebra	3 or 4
CAD 105	Introduction to Computer Graphics	2
Required	Communications Course	3
PSY 100	Introduction to Psychology	3
	Total	15 or 16

Summer

CAD 111	Computer Graphics: Mechanical Applications I	3
	Total	3

Fourth Semester

DFT 208	Applied Descriptive Geometry and Statics	5
CAD 211	Computer Graphics: Mechanical Applications II or CAD 213 Computer Graphics Electrical Applications II	4
GET 217	Industrial Manufacturing Processes and Materials	3
SPH 101	Fundamentals of Speech	3
	Total	15

APPENDIX

CADD AND CAM

CLASS SCHEDULES

SAMPLE PROJECTS

D. J. Johnson

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COMPUTER AIDED DESIGN & DRAFTING (CAD)

No student is allowed to register for CAD prefix classes without meeting the prerequisites. See the placement section in this schedule for complete details.

CAD 105 INTRODUCTION TO COMPUTER GRAPHICS (2) $71

1	M	9-10:00	16 WKS 1-14	D-218	CONSENT	
1A	T	8-10:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
1B	W	8-10:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
1C	TH	8-10:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
2	M	2-3:00	16 WKS 1-14	D-217	WEITZELL	
2A	T	2-4:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
2B	W	2-4:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
2C	TH	2-4:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	
3	M	6-7:00 P.M.	16 WKS 1-14	D-207	STAFF	
3A	M	4-8:00 (LAB)	16 WKS 1-14	D-215	STAFF	
3B	T	4-8:00 (LAB)	16 WKS 1-14	D-215	STAFF	
3C	W	4-8:00 (LAB)	16 WKS 1-14	D-215	STAFF	
4	F	6-7:00 P.M.	16 WKS 1-14	D-218	STAFF	
4A	F	8-10:00 P.M. (LAB)	16 WKS 1-14	D-215	STAFF	
4B	F	4-8:00 (LAB)	16 WKS 1-14	D-215	$106.50	
4C	T	8-8:00 PM (LAB)	16 WKS 1-14	D-215	CONSENT	

CAD 111 COMPUTER GRAPHICS—MECHANICAL APPLICATIONS I (3)

1	M	7-8:00 PM	16 WKS 1-14	D-207	STAFF	
	M	8-9:00 PM		D-215		
1A	M	9-11:00 PM (LAB)	16 WKS 1-14	D-215	STAFF	
1B	W	6-8:00 PM (LAB)	16 WKS 1-14	D-215	STAFF	
1C	F	8-8:00 PM (LAB)	16 WKS 1-14	D-215	KIMMEY	
2	F	10-11:00	16 WKS 1-14	D-215	KIMMEY	
	F	11-12:00		D-215	KIMMEY	
2A	F	12-2:00 (LAB)	16 WKS 1-14	D-215	KIMMEY	
2B	F	8-10:00 (LAB)	16 WKS 1-14	D-215	STAFF	
2C	M	8-10:00 (LAB)	16 WKS 1-14	D-215	$106.50	

CAD 113 COMPUTER GRAPHICS—ELECTRICAL APPLICATIONS I (3)

1	T	7-8:00 PM	16 WKS 1-14	D-210	CONSENT	
	T	8-9:00 PM		D-215	WEITZELL	
1A	T	9-11:00 PM (LAB)	16 WKS 1-14	D-215	WEITZELL	
1B	TH	6-8:00 PM (LAB)	8 WKS 1-14	D-215	WEITZELL	
1C	TH	4-6:00 (LAB)	16 WKS 1-14	D-215	WEITZELL	

CAD 211 COMPUTER GRAPHICS—MECHANICAL APPLICATIONS II (4)

1	W	7-8:00 PM	16 WKS 1-14	D-207	$142	
	W	8-9:00 PM		D-215	CONSENT	
1A	W	9-11:00 PM (LAB)	16 WKS 1-14	D-215	KIMMEY	
	S	10-12:00		D-215	KIMMEY	
1B	M	6-8:00 PM (LAB)	16 WKS 1-14	D-215	KIMMEY	
	S	8-10:00		D-215	KIMMEY	
1C	M	2-4:00 (LAB)	16 WKS 1-14	D-215	KIMMEY	
	F	2-4:00		D-215	KIMMEY	
1D	MW	10-12:00 (LAB)	16 WKS 1-14	D-215	KIMMEY	

CAD 213 COMPUTER GRAPHICS—ELECTRICAL APPLICATIONS II (4)

1	TH	7-8:00 PM	16 WKS 1-14	D-210	$142	
	TH	8-9:00 PM		D-215	CONSENT	
1A	TH	9-11:00 PM (LAB)	16 WKS 1-14	D-215	STAFF	
	S	12-2:00		D-215	STAFF	
1B	TTH	10-12:00 (LAB)	16 WKS 1-14	D-215	STAFF	

DFT 100 INTRODUCTION TO DRAFTING & ENGINEERING TECH. (1) $30.50 NONE

47	T	6:30-10:00 PM	8 WKS 1-28	A-4C DRAFT RM	STAFF

DFT 101 BASIC TECHNICAL DRAWING SKILLS (4) $112 MTH 096 OR EQUIVALENT

1	TTH	6:30-10:00 PM	16 WKS 1-14	D-208	STAFF

DFT 102 DESCRIPTIVE GEOMETRY (4) $112 DFT 101 OR CONSENT

1	MTWTH	8-9:50	16 WKS 1-14	D-208	KIMMEY
2	MTWTH	1-2:50	16 WKS 1-14	D-208	ROBERTS M
3	MW	6:30-10:00 PM	16 WKS 1-14	D-208	STAFF

DFT 206 INDUSTRIAL DESIGN PROBLEMS (5) $137.50 DFT 101

1	TTH	6:30-10:00 PM	16 WKS 1-14	D-207	STAFF

DFT 207 APPLIED MATHEMATICS FOR DRAFTING & DESIGN (3) $76.50 MTH 109 OR MTH 112

1	F	6:30-10:00 PM	16 WKS 1-14	D-207	ROBERTS M

MACHINE TOOL TECHNOLOGY

CAM 101 INTRODUCTION TO COMPUTER AIDED PROGRAMMING (2) $71 MTO 106, MTO 113, GET 107 OR CONSENT

50	F	6-8:00 PM	8 WKS 1-14	D-224	HENRYSON R	
	S	4-8:00		D-215		
51	TTH	10-11:00	8 WKS 3-12	D-224	WEITZELL	
	TTH	12-2:00		D-215		
52	F	6-8:00 PM	8 WKS 3-15	D-224	HENRYSON R	
	S	4-8:00		D-215		

CAM 222 COMPUTER AIDED MACHINING II (4) $102 CAM 220

1	F	1-3:00	16 WKS 1-14	D-232	STAFF
	MW	12-2:00		D-215	

CAM 223 SPECIAL PROBLEMS IN NC/CNC PROGRAMMING (2) $51 CAM 221 CAM 222

1	T.B.A.	T.B.A.	16 WKS 1-14	ECC TBA	STAFF

MTO 103 BASIC MACHINE TOOL OPERATIONS I (3) $81.50 NONE

1	TTH	7-9:20 PM	16 WKS 1-14	D-[illegible]225	STAFF

MTO 104 BASIC MACHINE TOOL OPEARATIONS II (3) $81.50 MTO 103

1	MW	7-9:20 PM	16 WKS 1-14	D-225/D-229	SCHULS
3	TTH	9-11:20	16 WKS 1-14	D-229/D-225	SCHULS

MTO 106 MATHEMATICS FOR MACHINISTS (5) $127.50 NONE

1	MW	7-9:20 PM	16 WKS 1-14	FSO 135	PERRIN

MTO 108 BASIC MACHINE TOOL OPERATIONS II (3) $81.50 MTO 103, MTO 104 MTO 105 OR CONSENT

1	MW	6:30-8:50 PM	16 WKS 1-14	D-225/D-229	SCHULS

MTO 109 BASIC MACHINE TOOL OPERATIONS IV (3) $81.50 MTO 108

1	TTH	6:30-8:50 PM	16 WKS 1-14	D-229/D-225	STAFF

MTO 110 MACHINE TOOL PROCESSES II (6) $183 MTO 104 OR MTO 105

1	MTWTHF	1-2:50	16 WKS 1-14	D-229/D-225	SCHULS

MTH 111 INTRODUCTION TO NUMERICAL CONTROL (1) $30.50 MTO 106, MTO 110

1	MW	9-9:50	8 WKS 1-14	D-229/D-225	MUNCH
2	F	6:30-8:20 PM	8 WKS 1-14	D-229	PERRIN

MTO 112 METROLOGY (3) $81.50 NONE

1	TTH	7:30-8:45	16 WKS 1-14	D-227/D-229	STAFF

MTO 113 DESIGN & FABRICATION OF MACHINE PARTS (5) $137.50 ALL FIRST SEMESTER COURSES

1	M	10-11:50	16 WKS 1-14	D-222	SCHULS
	TTH	9-12:00	16 WKS 1-14	D-225	

MTO 210 MACHINE TOOL PROCESSES IV (8) $234 MTO 205

1	MWF	7:30-11:50	16 WKS 1-14	D-229/D-225	MUNCH

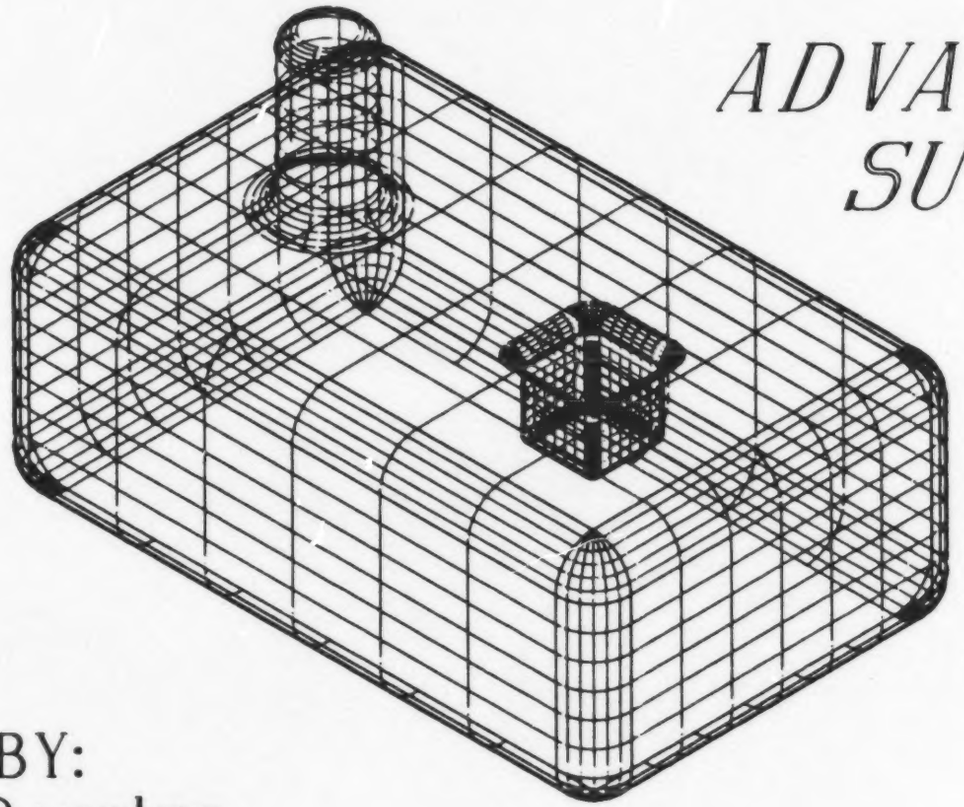
MTO 212 METALLURGY (3) $86.50 NONE

1	F	8:30-12:20	16 WKS 1-14	D-226/D-218	SCHULS

MTO 214 JIG & FIXTURE THEORY (3) $51 MTO 110

1	TTH	9-9:50	16 WKS 1-14	D-232	MUNCH

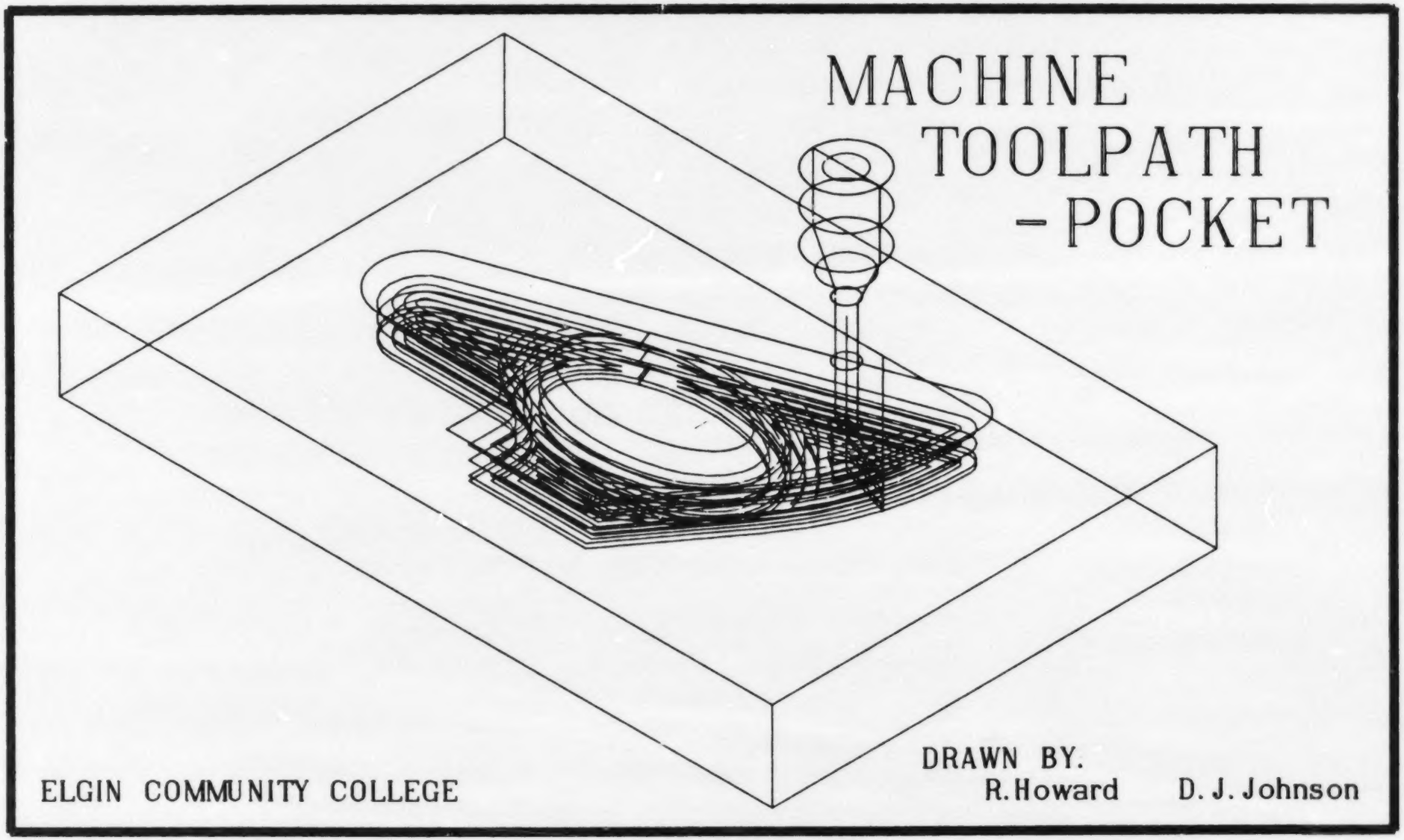
12



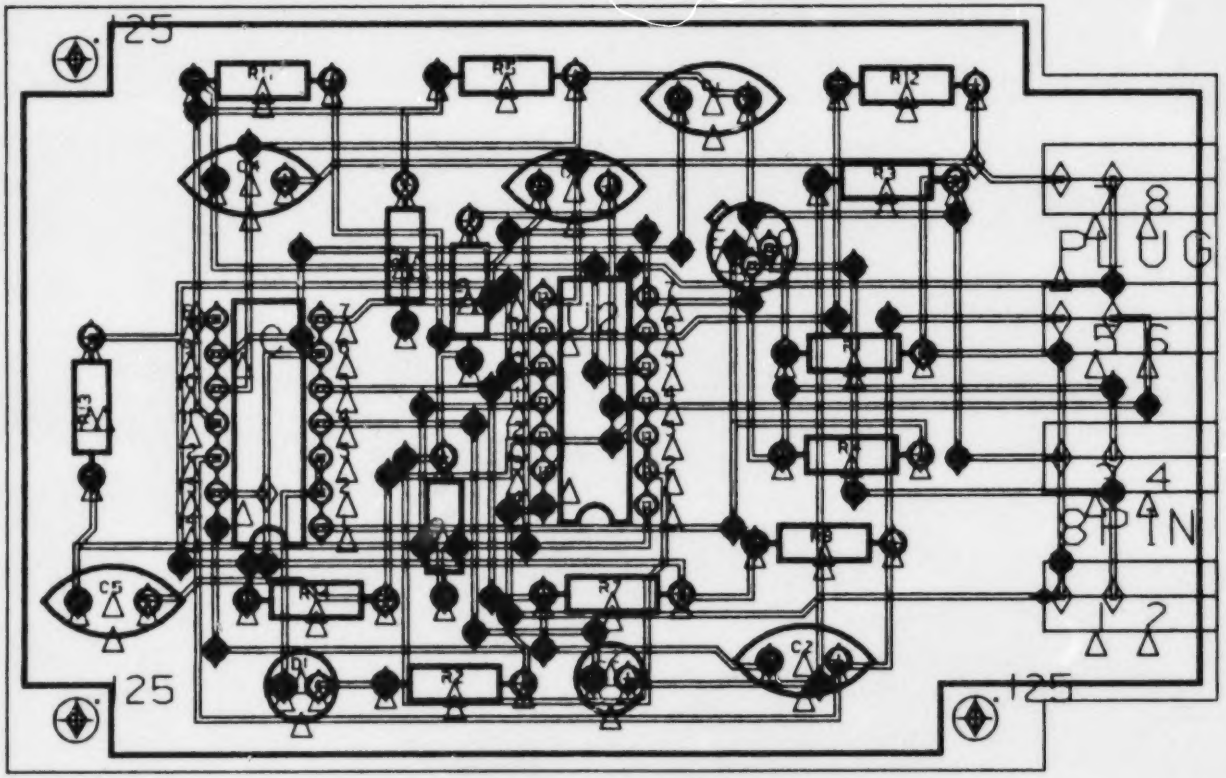
ADVANCED SURFACING PROJECT

DRAWN BY:
Bob Douglas
Steve Dillett

ELGIN COMMUNITY COLLEGE


MACHINE
TOOLPATH
-POCKET
ELGIN COMMUNITY COLLEGE
DRAWN BY.
R.Howard
D.J.Johnson

CADDS 113 ELECTRICAL DESIGN



Information for ACADEMIC Directory

Name of Institution or University: Elgin Community College

Department or Division: Computer Aided Design and Drafting

Course Title: Introduction to Computer Graphics (CAD 105)

Prerequisites: MTH 096 (Basic Algebra)

DFT 101 (Basic Technical Drawing Skills or Equivalent)

Nature of Course:

Undergraduate X Graduate ____ Continuing Education X

Required X or Elective X

Instructor:

Name: Dennis Wietzell, Maynard Roberts, Jim Kimmey, Phyllis Earls

Title: CAD Instructors

Address: Elgin Community College

1700 Spartan Drive, Elgin, IL 60120

Phone: 312 888-7359

Course Offering:

System CV Credit hours 2 No. of Offerings/year 10 No.of Classes/Term 4

No. of Students/Class 30 per lecture / 10 per lab No. of hours on CV/Student/Week 2 hours per wk. lecture, 4 hours per wk. lab, 8 wks. total Summer 2

Methods of Instruction:

Lectures X Lab.Demos. X Counseling ___ Handouts X

Methods of Evaluation:

Homeworks ___% Quizes 20% Final 20% Project(s) 60%

Other

Course Description:

A computer aided design (CAD) system allows an engineer, designer, or drafts-person to interactively create and or modify designs seen on a graphics display screen. It is essential that all engineers, designers, and technicians become aware of this rapidly growing technology. This course will provide the student with the opportunity to become familiar with the finest computer-aided design equipment available today, a Computervision Designer V station with CADDS 4 software. The class consists of both lecture and labs providing the opportunity to become familiar with the basic command system and the hardware configuration of a CAD turnkey system. A series of lab excercises utilizing the Designer V work station are used to facilitate learning the basic system commands.

Instructional Materials:

CADDS 4 Pocket Reference (Computervision)
CADDS 4 Concept Book - Mechanical (Computervision)
Hand out and Assignment Sheets

Course Outline:

Section I

A. Engineering Disciplines Being Addressed
B. The Role of a CADDS Terminal Operator

Section II

A. Introduction to the Equipment
   Hardware vs Softare
B. Boot-up Process
C. Crash Recover
D. Logging on System
E. Task/Work Space
F. Part Naming Convention

Section III

A. Basic Command Structure
B. Syntax
C. Data Input (get data)
D. Explicit Coordinates
E. Get Data Filters and Modifiers
F. Punctuation
G. Special Control Characters
H. Data Base Construction Commands
I. On Line Documentation

Section IV

A. Model Mode vs Draw Mode
B. Mode Selection/Identification
C. Defining Views
D. Defining Construction Planes
E. Selecting CPL's
F. User-Defined CPL's
G. Set X Y or Z

Section V

A. Grids
B. Layering
C. Dimensioning

Section VI

A. Output Devices
B. Terminal Thermal Printer
   (Plot Hardcopy)

Section VII

A. Text
B. Selecting Text
   (Font, Hgt, Slt, etc.)
C. Edit Text

Information for ACADEMIC Directory

Name of Institution or University: Elgin Community College

Department or Division: Computer Aided Design and Drafting

Course Title: CAD 111, Mechanical Applications I

Prerequisites: CAD 105, Introduction to Computer Graphics
DFT 102, Descriptive Geometry
MTH 111, Intermediate Algebra

Nature of Course:

Undergraduate X Graduate ____ Continuing Education X

Required X Elective ____

Instructor:

Name:	James R. Kimmey	Joe Nelson
Title:	CAD Instructor	Applications Engineer
Address:	Elgin Community College	Computervision Corporation
	1700 Spartan Dr., Elgin, IL	Arlington Heights, IL
Phone:	(312) 888-7359	(312) 870-2828

Course Offering:

System CV Credit Hours 3 No. of Offerings/Year ____ No. of Classes/Term ____

No. of Students/Class ____ No. of hours on CV/Student/Week ____

Methods of Instruction:

Lectures X Lab Demos. X Counseling ____ Handouts X

Methods of Evaluation:

Homeworks ____% Quizzes ____% Final ____% Project(s) ____%

Other ____

Course Description:

This course will provide the technology and engineering student with the opportunity to perform 3-D modeling, create assembly and detail drawings, utilize and create part figures, and to develop and create execute files. Menu design and basic system maintenance are an intergral part of the course. An introduction to surfacing will be presented. Instruction includes both lecture and laboratory experiences using Computervision's CADDS 4 software and Instaview work stations.

Instructional Materials:

Faculty prepared hand-out and assignment sheets.

Course Outline:

I. Views and Construction Planes

A. Fundamental Concepts

B. Views

1. view definition

a. associativity
b. multi-view digitizing

2. view dynamics

a. ICU - Zoom, Scroll, Rotate
b. within getdata
c. special views commands

C. Construction Planes

1. concepts
2. system pre-defined planes

a. special CPl features

3. lab exercise - views and Cplanes
4. outside assignment

D. Complex Construction Processes

1. Project Entity

a. key modifiers
b. prompts

2. Lab Exercise - Intro. to 3-D Modeling

II. CADDS 4 Three-Dimensional Modeling

A. Introduction

1. concepts
2. benefits

B. Views and Construction Planes

1. user-defined construction planes

a. auxiliary planes
b. from existing
c. angle
d. normal

C. Part Verification/Identification

1. Verify

a. entity

2. Measurement and Calculations

a. distance
b. length
c. angle
d. area

3. Identification

a. tags
b. marks

4. Status

5. Discrimination

a. layers
b. entities

6. Lab Exercise - Part Verification

D. Design Drafting Input Aids

1. dynamic input

a. dragging
b. rubberbanding

2. Part Figures

a. concepts
b. preparation
c. insertion
d. special part feature

1. list
2. change
3. select
4. update
5. copy
6. construct

3. Lab Exercise - Part Figures

4. Outside Assignment

III. Menus

A. Tablet

1. key files
2. edit files
3. save key

B. Exercise

IV. Basic Futil

A. Copy disc to tape
B. Copy tape to disc
C. Lab Exercise

V. Introduction to Surfacing

A. Use of SREV, Ruled Surfaces, T Cylinders
B. Cut Plane
C. Cut Surface

Information for ACADEMIC Directory

Name of Institution or University: Elgin Community College

Department or Division: Computer Aided Design and Drafting

Course Title: CAD 113, Electrical Applications I

Prerequisites: CAD 105, Introduction to Computer Graphics
MTH 111, Intermediate Algebra
ELS 100, Basic Electronics or Equivalent

Nature of Course:

Undergraduate X Graduate _____ Continuing Education X

Required X Elective _____

Instructor:

Name:	Dennis Weitzell	Bob Holderness
Title:	CAD Instructor	CAD/CAM Manager
Address:	Elgin Community College	Motorola Corporation
	Elgin, Illinois	Schaumburg, Illinois
Phone:	(312) 888-7359	(312) 576-5828

Course Offering:

System CV Credit Hours 3 No. of Offerings/Year 5 No. of Classes/Term 2

No. of Students/Class 30 Lecture
10 per lab

No. of hours on CV/Student/Week 1 hr. lecture
1 hr. demo.
2 hr. lab
16 weeks

Methods of Instruction:

Lectures X Lab Demos. X Counseling _____ Handouts X

Methods of Evaluation:

Homeworks ____% Quizzes ____% Final ____% Project(s) ____%

Other _____

Course Description:

Provides the student with an understanding of Computervision's CADDS 4 System and the software associated with electrical design. The student will gain a thorough knowledge of digitizing a schematic, building a parts library, running and merging a net list, and routing a printed circuit board. Included will be instructions on editing and tieing into manufacturing and routing a P.C.B. instruction includes lecture and laboratory hours utilizing Designer V stations.

Instructional Area:

Faculty developed hand-out sheets.

Course Outline:

I. The Computervision CADDS 4 Electrical Design Software

- A. Graphic Function
- B. Utility Function
- C. Filing Functions
- D. Data Storage

II. Operation of the Computervisions CADDS 4 System

A. Building schematic library symbols

1. insertion of string lines to create graphics
2. insertion of tnods
3. insertion of cnods
4. 4 lab exercises

B. Digitizing the Schematics

1. insert nodal figures
2. insert nodal lines
3. insert nodal text
4. tie in power and ground signals
5. run net list
6. edit the net list using text files
7. lab exercises

C. Building printed circuit library parts

1. create graphics
2. insert pads, drill figures and auto-insertion information
3. insert cnods, tnods
4. insert S figs, N figs, and P figs
5. add part codes
6. lab exercises

D. Build printed circuit board outline

1. use of automatic dimensioning
2. use of manual dimensioning
3. insert finger edge connectors
4. lab exercises

E. Placement of components into printed circuit board

1. insert nodal figures
2. add reference designations
3. megre schematic net list into data base
4. edit printed circuit board
5. use data extract

a. bill of materials

III. The application of CADDS 4 techniques to machining processes

A. Introduction

B. The CAD/CAM System

1. Drilling

a. discussion of paper punch type

2. Photo-plotting
3. Automatic insertion information

C. The future of CAD/CAM

Information for ACADEMIC Directory

Name of Institution or University: Elgin Community College

Department or Division: Computer Aided Design and Drafting

Course Title: CAD 211, Mechanical Applications II

Prerequisites: CAD 111, MTH 112 (College Algebra or Equivalent), 200 Level Drafting Course or Equivalent Work Experience

Nature of Course:

Undergraduate X Graduate ____ Continuing Education X

Required ____ Elective X

Instructor:

Name: James R. Kimmey

Title: Computer Aided Design and Drafting Instructor

Address: Elgin Community College
1700 Spartan Drive, Elgin, Illinois 60120

Phone: (312) 888-7359

Course Offering:

System CV Credit Hours 4 No. of Offerings/Year 3 No. of Classes/Term 1 Fall 2 Spring

No. of Students/Class 30 Lecture (10 students per lab) No. of hours on CV/Student/Week 4 lab hrs. per week for 16 weeks, 2 hrs. lecture per week

Methods of Instruction:

Lectures X Lab Demos. X Counseling ____ Handouts X

Methods of Evaluation:

Homeworks 10% Quizzes 10 % Final 10 % Project(s) 70 %

Other ____

Course Description:

Mechanical Applications II is an extention of Mechanical Applications I with the addition of several new areas. New units of study include: fold and unfold flat patterns; generating tool paths; advanced detailing techniques, and surfacing, including C Poles and S Poles.

Instructional Materials:

Projects and handout sheets developed by industrial Computervision users and college staff.

Course Outline:

1. Create Assemblies and Component Drawings Utilizing Two Methods:

   A. Separate Part (&PD) Concept
   B. Same Part (&PD) Concept
   C. Detailing Techniques

2. Copying Parts from:

   A. Disc to Tape
   B. Tape to Disc
   C. Part to Part

3. Review of Commands:

   A. System Control Commands
   B. Part Structuring Commands
   C. Data Base Construction
   D. Get Data
   E. Data Base Visualization

      - Save Image
      - Restore Image
      - Reset View
      - Dyna View

   F. Menu Commands
   G. Part/Drawing Verification

4. New Commands being Addressed:

   A. Save Parameters
   B. Proj Ent Scale
   C. Revise Entity
   D. Copy Detail
   E. Echo Fil On
   F. Etc.

5. Utilizing Execute Files:

   A. Creating a &BCD File
   B. Editing &BCD File
   C. Execution of Files
   D. Building Parts
   E. Building Text Files (TFiles)
   F. File Nomenclature

6. Fold-Unfold Patterns

7. Tool Pathing

   A. Machine Print-to-Print
   B. Machine Profile
   C. Machine Pocket
   D. Machine Surface
   E. Use of Regenerate Commands

8. Surfacing Techniques

   A. C Poles
   B. S Poles
   C. L Rillets
   D. Creating parts with extensive use of fillets and rounds.

Information for ACADEMIC Directory

Name of Institution or University: Elgin Community College

Department or Division: Computer Aided Design and Drafting

Course Title: CAD 213, Electrical Applications II

Prerequisites: CAD 113, MTH 112 (College Algebra or Equivalent),
ELS 100, 200 Level Drafting Course

Nature of Course:

Undergraduate X Graduate ____ Continuing Education X

Required ____ Elective X

Instructor:

Name: Frank Bader

Title: Computer Aided Design and Drafting Instructor

Address: Elgin Community College
1700 Spartan Drive, Elgin, Illinois 60120

Phone: (312) 697-1000 ext. 276

Course Offering:

System CV Credit Hours 4 No. of Offerings/Year 2 No. of Classes/Term 1

No. of Students/Class 30 (10 students per lab) Lecture No. of hours on CV/Student/Week 4 lab hrs. per week for 16 weeks.

Methods of Instruction:

Lectures X Lab Demos. X Counseling ____ Handouts X

Methods of Evaluation:

Homeworks 10 % Quizzes 10 % Final 10 % Project(s) 70 %

Other ____

Course Description:

CAD 213 is an advanced curriculum using the latest state-of-the-art software for printed circuit board design.

This course is an expansion of the CAD 113 class and will provide the student with the opportunity to more fully utilize the power of the Computervision CADDS 4 System.

Instructional Materials:

Projects and handout sheets developed by industrial Computervision users and college staff.

Course Outline:

1. Creation of a schematic for P.C. Board Design
   - A. Nodal Figure Insertion
   - B. Nodal Line Signaling
   - C. Text Manipulation
2. Creation of the Board Outline
   - A. Insertion of the Board Edge
   - B. Insertion of Placement "Keep-in" and "Keep-out" Areas
   - C. Insertion of Router "Keep-in" and "Keep-out" Areas
3. Creation of Parameter Files and Text Files
   - A. Study on Meaning and Use of "EDF" Files
   - B. "ELF" Extraction
   - C. "CLF" Creation
   - D. "P File" Usage
4. Automatic Component Placement
   - A. Discussion of Criteria used in Auto Place
   - B. Automatic and Interactive Placement
   - C. Placement Evaluation

ELGIN COMMUNITY COLLEGE
ELGIN, ILLINOIS

COURSE OUTLINE

COURSE NUMBER: CAD 217 (Variable Credit 1-4)

COURSE TITLE: Independent Research in Computer-Aided Design

INSTRUCTIONAL AREA: Computer Aided Design and Drafting

I. DESCRIPTION: Because of the diversity and depth of the Computervision CADDS 4X system there is a need to increase the learning opportunities for those students desiring to expand their knowledge and skills beyond that which are presently offered in our regular CAD classes. Areas of study, under the supervision of an instructor, would include such areas as plastic mold design, FEM, advanced auto-route, auto-place, advanced surfacing and shading techniques, robographics, Auto-nest, CAE, NEWVAR and P.C. manufacturing.

Prequisite: CAD 211 for mechanical; CAD 213 for electrical and consent of instructor.

Note: This Class is available only as space in the lab permits.

II. TEXTBOOKS (RECOMMENDED, REQUIRED):

Computervision reference manuals and on-line documentation.

III. RESERVE BOOKS:

BEST COPY AVAILABLE

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